

WHAT IS CLAIMED IS:

1. An adjustment method of characteristics of a multistage Mach-Zehnder interferometer type optical circuit that includes:
 - a first input/output optical waveguide pair;
 - a second input/output optical waveguide pair;
 - M directional couplers disposed between said first and second input/output optical waveguide pairs, where
- 5 M is an integer equal to or greater than two; and
- 10 (M-1) phase control means, each of which is disposed between two adjacent directional couplers of said M directional couplers, is attached to at least one of two optical waveguides of the optical waveguide pair
- 15 placed between said adjacent directional couplers, and controls relative phase of light beams passing through a first optical waveguide and a second optical waveguide of said optical waveguide pair in response to a phase control signal, wherein
- 20 said adjacent directional couplers, said phase control means disposed between said adjacent directional couplers, and said optical waveguide pairs that are disposed between said directional couplers and have same optical path lengths constitute symmetrical
- 25 Mach-Zehnder type optical interferometers, whereas said adjacent directional couplers, said phase control means disposed between said adjacent directional

couplers, and said optical waveguide pairs that are disposed between said directional couplers and have different optical path lengths constitute asymmetrical Mach-Zehnder type optical interferometers, and (M-1) 5 Mach-Zehnder type optical interferometers are connected in cascade to construct said multistage Mach-Zehnder interferometer type optical circuit, said adjustment method of the characteristics of the multistage Mach-Zehnder interferometer type optical 10 circuit comprising:

a first step of sequentially carrying out, for each of said symmetrical Mach-Zehnder interferometers, setting of the phase control signal based on a correlation between the phase control signal of said 15 phase control means disposed in said symmetrical Mach-Zehnder interferometer and optical intensity output from a first optical waveguide of said second input/output optical waveguide pair disposed in an output side of said multistage Mach-Zehnder 20 interferometer type optical circuit, after inputting low coherence light, which has a coherence length shorter than a minimum optical path length difference between said asymmetrical Mach-Zehnder interferometers, from a first optical waveguide of said first input/output 25 optical waveguide pair disposed at an input side of said multistage Mach-Zehnder interferometer type optical circuit;

a second step of sequentially carrying out, for each of said asymmetrical Mach-Zehnder interferometers, setting of the phase control signal based on a correlation between the phase control signal of said 5 phase control means disposed in said asymmetrical Mach-Zehnder interferometer and optical intensity output from one of first and second optical waveguides of said second input/output optical waveguide pair disposed in the output side of said multistage 10 Mach-Zehnder interferometer type optical circuit, after inputting wavelength tunable coherent light from one of first and second optical waveguides of said first input/output optical waveguide pair disposed at the input side of said multistage Mach-Zehnder 15 interferometer type optical circuit; and

a third step of optimizing the individual phase control signals of said phase control means to achieve a desired characteristic of the output light from said multistage Mach-Zehnder interferometer type optical 20 circuit based on the correlations between the phase control signals and output light intensity obtained at the first step and the second step.

2. The adjustment method of the characteristics of the 25 multistage Mach-Zehnder interferometer type optical circuit as claimed in claim 1, wherein

an optical input to said multistage Mach-Zehnder

interferometer type optical circuit at the first step
and the second step is carried out by using optical path
switching means including two optical input sections
and two optical output sections and capable of selecting
5 an optical path between the optical input sections and
the optical output sections, in which said two optical
input sections are connected to the low coherence light
and the wavelength tunable coherent light, respectively,
said two optical output sections are connected to said
10 first input/output optical waveguide pair, and said
optical path switching means carries out optical path
switching to select one of the low coherence light and
the wavelength tunable coherent light as the input light.

15 3. The adjustment method of the characteristics of the
multistage Mach-Zehnder interferometer type optical
circuit as claimed in claim 1, wherein

the setting of each of the phase control signals
at the first step is carried out in response to the optical
20 output intensity from the first optical waveguide of
said second input/output optical waveguide pair such
that the phase control signal of said phase control means
disposed in said symmetrical Mach-Zehnder
interferometer makes an intensity-coupling ratio of
25 said symmetrical Mach-Zehnder interferometer equal to
one of 0% and 100%; and
the setting of each of the phase control signals

at the second step is carried out such that an intensity-coupling ratio of two of said symmetrical Mach-Zehnder interferometers adjacent to both ends of each of said asymmetrical Mach-Zehnder interferometers 5 becomes 50%, and intensity-coupling ratios of the symmetrical Mach-Zehnder interferometers other than the two symmetrical Mach-Zehnder interferometers become one of 0% and 100%, by setting the phase control signals of the phase control means disposed in said 10 symmetrical Mach-Zehnder interferometers based on the correlations obtained at the first step, and such that intensity-coupling ratios of said asymmetrical Mach-Zehnder interferometers become one of 0% and 100%.

15 4. The adjustment method of the characteristics of the multistage Mach-Zehnder interferometer type optical circuit as claimed in claim 3, wherein
an optical input to said multistage Mach-Zehnder interferometer type optical circuit at the first step
20 and the second step is carried out by using optical path switching means including two optical input sections and two optical output sections and capable of selecting an optical path between the optical input sections and the optical output sections, in which said two optical
25 input sections are connected to the low coherence light and the wavelength tunable coherent light, respectively, said two optical output sections are connected to said

first input/output optical waveguide pair, and said optical path switching means carries out optical path switching to select one of the low coherence light and the wavelength tunable coherent light as the input light.

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5. The adjustment method of the characteristics of the multistage Mach-Zehnder interferometer type optical circuit as claimed in claim 1, wherein

the settings of the phase control signals at the
10 first step and the second step are each carried out sequentially from said phase control means disposed in the output side of said multistage Mach-Zehnder interferometer type optical circuit toward said phase control means disposed in the input side of said
15 multistage Mach-Zehnder interferometer type optical circuit.

6. The adjustment method of the characteristics of the multistage Mach-Zehnder interferometer type optical
20 circuit as claimed in claim 5, wherein

an optical input to said multistage Mach-Zehnder interferometer type optical circuit at the first step and the second step is carried out by using optical path switching means including two optical input sections
25 and two optical output sections and capable of selecting an optical path between the optical input sections and the optical output sections, in which said two optical

input sections are connected to the low coherence light and the wavelength tunable coherent light, respectively, said two optical output sections are connected to said first input/output optical waveguide pair, and said 5 optical path switching means carries out optical path switching to select one of the low coherence light and the wavelength tunable coherent light as the input light.

7. The adjustment method of the characteristics of the 10 multistage Mach-Zehnder interferometer type optical circuit as claimed in claim 3, wherein

the settings of the phase control signals at the first step and the second step are each carried out sequentially from said phase control means disposed in 15 the output side of said multistage Mach-Zehnder interferometer type optical circuit toward said phase control means disposed in the input side of said multistage Mach-Zehnder interferometer type optical circuit.

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8. The adjustment method of the characteristics of the multistage Mach-Zehnder interferometer type optical circuit as claimed in claim 7, wherein

an optical input to said multistage Mach-Zehnder 25 interferometer type optical circuit at the first step and the second step is carried out by using optical path switching means including two optical input sections

and two optical output sections and capable of selecting an optical path between the optical input sections and the optical output sections, in which said two optical input sections are connected to the low coherence light 5 and the wavelength tunable coherent light, respectively, said two optical output sections are connected to said first input/output optical waveguide pair, and said optical path switching means carries out optical path switching to select one of the low coherence light and 10 the wavelength tunable coherent light as the input light.

9. An adjustment method of characteristics of a multistage Mach-Zehnder interferometer type optical circuit that includes:

15 a first input/output optical waveguide pair;
a second input/output optical waveguide pair;
2(N+1) directional couplers disposed between said first and second input/output optical waveguide pairs, where N is an integer equal to or greater than one; and
20 (2N+1) phase control means, each of which is disposed between two adjacent directional couplers of said 2(N+1) directional couplers, is attached to at least one of two optical waveguides of the optical waveguide pair placed between said adjacent directional couplers,
25 and controls relative phase of light beams passing through a first optical waveguide and a second optical waveguide of said optical waveguide pair in response

to a phase control signal, wherein
said adjacent directional couplers, said phase
control means disposed between said adjacent
directional couplers, and said optical waveguide pairs
5 that are disposed between said directional couplers and
have same optical path lengths constitute symmetrical
Mach-Zehnder type optical interferometers, whereas
said adjacent directional couplers, said phase control
means disposed between said adjacent directional
10 couplers, and said optical waveguide pairs that are
disposed between said directional couplers and have
different optical path lengths constitute asymmetrical
Mach-Zehnder type optical interferometers, and (N+1)
said symmetrical Mach-Zehnder type optical
15 interferometers and N said asymmetrical Mach-Zehnder
type optical interferometers are alternately connected
in cascade to construct said multistage Mach-Zehnder
interferometer type optical circuit, said adjustment
method of the characteristics of the multistage
20 Mach-Zehnder interferometer type optical circuit
comprising:

a first step of sequentially carrying out, for each
of said symmetrical Mach-Zehnder interferometers,
setting of the phase control signal based on a
25 correlation between the phase control signal of said
phase control means disposed in said symmetrical
Mach-Zehnder interferometer and optical intensity

output from a first optical waveguide of said second input/output optical waveguide pair disposed in an output side of said multistage Mach-Zehnder interferometer type optical circuit, after inputting 5 low coherence light, which has a coherence length shorter than a minimum optical path length difference between said asymmetrical Mach-Zehnder interferometers, from a first optical waveguide of said first input/output optical waveguide pair disposed at an input side of said 10 multistage Mach-Zehnder interferometer type optical circuit;

a second step of sequentially carrying out, for each of said asymmetrical Mach-Zehnder interferometers, setting of the phase control signal based on a 15 correlation between the phase control signal of said phase control means disposed in said asymmetrical Mach-Zehnder interferometer and optical intensity output from one of first and second optical waveguides of said second input/output optical waveguide pair 20 disposed in the output side of said multistage Mach-Zehnder interferometer type optical circuit, after inputting wavelength tunable coherent light from one of first and second optical waveguides of said first input/output optical waveguide pair disposed at the 25 input side of said multistage Mach-Zehnder interferometer type optical circuit; and

a third step of optimizing the individual phase

control signals of said phase control means to achieve a desired characteristic of the output light from said multistage Mach-Zehnder interferometer type optical circuit based on the correlations between the phase 5 control signals and output light intensity obtained at the first step and the second step.

10. The adjustment method of the characteristics of the multistage Mach-Zehnder interferometer type 10 optical circuit as claimed in claim 9, wherein

an optical input to said multistage Mach-Zehnder interferometer type optical circuit at the first step and the second step is carried out by using optical path switching means including two optical input sections 15 and two optical output sections and capable of selecting an optical path between the optical input sections and the optical output sections, in which said two optical input sections are connected to the low coherence light and the wavelength tunable coherent light, respectively, 20 said two optical output sections are connected to said first input/output optical waveguide pair, and said optical path switching means carries out optical path switching to select one of the low coherence light and the wavelength tunable coherent light as the input light.

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11. The adjustment method of the characteristics of the multistage Mach-Zehnder interferometer type

optical circuit as claimed in claim 9, wherein
the setting of each of the phase control signals
at the first step is carried out in response to the optical
output intensity from the first optical waveguide of
5 said second input/output optical waveguide pair such
that the phase control signal of said phase control means
disposed in said symmetrical Mach-Zehnder
interferometer makes an intensity-coupling ratio of
said symmetrical Mach-Zehnder interferometer equal to
10 one of 0% and 100%; and

the setting of each of the phase control signals
at the second step is carried out such that an
intensity-coupling ratio of two of said symmetrical
Mach-Zehnder interferometers adjacent to both ends of
15 each of said asymmetrical Mach-Zehnder interferometers
becomes 50%, and intensity-coupling ratios of the
symmetrical Mach-Zehnder interferometers other than
the two symmetrical Mach-Zehnder interferometers
become one of 0% and 100%, by setting the phase control
20 signals of the phase control means disposed in said
symmetrical Mach-Zehnder interferometers based on the
correlations obtained at the first step, and such that
intensity-coupling ratios of said asymmetrical
Mach-Zehnder interferometers become one of 0% and 100%.

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12. The adjustment method of the characteristics of
the multistage Mach-Zehnder interferometer type

optical circuit as claimed in claim 11, wherein
an optical input to said multistage Mach-Zehnder
interferometer type optical circuit at the first step
and the second step is carried out by using optical path
5 switching means including two optical input sections
and two optical output sections and capable of selecting
an optical path between the optical input sections and
the optical output sections, in which said two optical
input sections are connected to the low coherence light
10 and the wavelength tunable coherent light, respectively,
said two optical output sections are connected to said
first input/output optical waveguide pair, and said
optical path switching means carries out optical path
switching to select one of the low coherence light and
15 the wavelength tunable coherent light as the input light.

13. The adjustment method of the characteristics of
the multistage Mach-Zehnder interferometer type
optical circuit as claimed in claim 9, wherein
20 the settings of the phase control signals at the
first step and the second step are each carried out
sequentially from said phase control means disposed in
the output side of said multistage Mach-Zehnder
interferometer type optical circuit toward said phase
25 control means disposed in the input side of said
multistage Mach-Zehnder interferometer type optical
circuit.

14. The adjustment method of the characteristics of the multistage Mach-Zehnder interferometer type optical circuit as claimed in claim 13, wherein

5 an optical input to said multistage Mach-Zehnder interferometer type optical circuit at the first step and the second step is carried out by using optical path switching means including two optical input sections and two optical output sections and capable of selecting
10 an optical path between the optical input sections and the optical output sections, in which said two optical input sections are connected to the low coherence light and a light source of the wavelength tunable coherent light, respectively, said two optical output sections
15 are connected to said first input/output optical waveguide pair, and said optical path switching means carries out optical path switching to select one of the low coherence light and the wavelength tunable coherent light as the input light.

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15. The adjustment method of the characteristics of the multistage Mach-Zehnder interferometer type optical circuit as claimed in claim 11, wherein

25 the settings of the phase control signals at the first step and the second step are each carried out sequentially from said phase control means disposed in the output side of said multistage Mach-Zehnder

interferometer type optical circuit toward said phase control means disposed in the input side of said multistage Mach-Zehnder interferometer type optical circuit.

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16. The adjustment method of the characteristics of the multistage Mach-Zehnder interferometer type optical circuit as claimed in claim 15, wherein

an optical input to said multistage Mach-Zehnder interferometer type optical circuit at the first step and the second step is carried out by using optical path switching means including two optical input sections and two optical output sections and capable of selecting an optical path between the optical input sections and the optical output sections, in which said two optical input sections are connected to the low coherence light and a light source of the wavelength tunable coherent light, respectively, said two optical output sections are connected to said first input/output optical waveguide pair, and said optical path switching means carries out optical path switching to select one of the low coherence light and the wavelength tunable coherent light as the input light.

25 17. A multistage Mach-Zehnder interferometer type optical circuit comprising:

a first input/output optical waveguide pair;

a second input/output optical waveguide pair;
 M directional couplers disposed between said first
and second input/output optical waveguide pairs, where
M is an integer equal to or greater than two; and
5 (M-1) phase control means, each of which is disposed
between two adjacent directional couplers of said M
directional couplers, is attached to at least one of
two optical waveguides of the optical waveguide pair
placed between said adjacent directional couplers, and
10 controls relative phase of light beams passing through
a first optical waveguide and a second optical waveguide
of said optical waveguide pair in response to a phase
control signal, wherein

 said adjacent directional couplers, said phase
15 control means disposed between said adjacent
directional couplers, and said optical waveguide pairs
that are disposed between said directional couplers and
have same optical path lengths constitute symmetrical
Mach-Zehnder type optical interferometers, whereas
20 said adjacent directional couplers, said phase control
means disposed between said adjacent directional
couplers, and said optical waveguide pairs that are
disposed between said directional couplers and have
different optical path lengths constitute asymmetrical
25 Mach-Zehnder type optical interferometers, and (M-1)
Mach-Zehnder type optical interferometers are
connected in cascade to construct said multistage

Mach-Zehnder interferometer type optical circuit,
wherein

5 said symmetrical Mach-Zehnder type optical
interferometers and said asymmetrical Mach-Zehnder
type optical interferometers connected in cascade are
subjected to the characteristic adjustment according
to the method as defined in claim 1.

18. A multistage Mach-Zehnder interferometer type
10 optical circuit comprising:

 a first input/output optical waveguide pair;
 a second input/output optical waveguide pair;
 2(N+1) directional couplers disposed between said
 first and second input/output optical waveguide pairs,
15 where N is an integer equal to or greater than one; and
 (2N+1) phase control means, each of which is
 disposed between two adjacent directional couplers of
 said 2(N+1) directional couplers, is attached to at least
 one of two optical waveguides of the optical waveguide
20 pair placed between said adjacent directional couplers,
 and controls relative phase of light beams passing
 through a first optical waveguide and a second optical
 waveguide of said optical waveguide pair in response
 to a phase control signal, wherein
25 said adjacent directional couplers, said phase
 control means disposed between said adjacent
 directional couplers, and said optical waveguide pairs

that are disposed between said directional couplers and have same optical path lengths constitute symmetrical Mach-Zehnder type optical interferometers, whereas said adjacent directional couplers, said phase control 5 means disposed between said adjacent directional couplers, and said optical waveguide pairs that are disposed between said directional couplers and have different optical path lengths constitute asymmetrical Mach-Zehnder type optical interferometers, and (N+1) 10 said symmetrical Mach-Zehnder type optical interferometers and N said asymmetrical Mach-Zehnder type optical interferometers are alternately connected in cascade to construct said multistage Mach-Zehnder interferometer type optical circuit, wherein 15 said (N+1) symmetrical Mach-Zehnder type optical interferometers and said N asymmetrical Mach-Zehnder type optical interferometers connected in cascade are subjected to the characteristic adjustment according to the method as defined in claim 9.

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